**"Molecules In Motion"**

Physical Science, 4th Grade

**Aim:**  What is the effect of heat energy on water?

**Preparatory Time:**  40 minutes

**Activity Time:**  50 minutes

**Skills:**  Analyzing (identifying patterns), Interpreting (summarizing), Presenting (drawing, writing)

**Vocabulary:**  kinetic energy, heat energy, evaporation, condensation, solid, liquid, gas, water molecule(s)

**Objective:**  Students will model the effects of heat energy on the different states of water.

**Materials:**  samples of water in each state (ice, a glass of water, and boiling water), 2 flashlights (one covered with a red filter and 1 covered with blue filter)

**Background:**

     Water is made of molecules; each water molecule contains two hydrogen atoms and one atom of oxygen.  Molecules constantly move.  Heat energy contributes to the motion of molecules (kinetic energy).  When water feels warm, molecules are moving very rapidly.  Water molecules with little heat energy, such as those in and ice cube, move more slowly.

**Procedure:**

**Warm Up**

Have students write down or draw pictures of what happens to an ice cube on a window ledge as the weather turns warmer.  Discuss their views and collect their papers.

          Discuss and compare the three states of water.  (A sample of each will be available.)  Have students identify the conditions needed to exist.

          Ask; What happens when water evaporates? Where does water go?  Students may know or guess the answer.  Help them to understand that water has been broken down to its tiniest form, a water molecule.

          Tell students that water is made up of millions of tiny molecules.  A cookie appears to be one solid piece, but when crumbled it is made up of tiny pieces.  This analogy can be used to help young learners understand the particulate nature of matter.

**The Activity**

**1.** Tell the class they are going to become water molecules.  They will begin as water in its solid form, ice.  As ice, students stand in place and move very little.

**2.** Inform students that for this activity a flashlight with the red filter will be used to represent the addition of heat energy.  Shining the light on a student represents heat energy traveling from an outside source to that water molecule (student), resulting in increased temperature and molecular motion (kinetic energy).

**3.**  Beam the flashlight on a few students.  They should begin to move slowly in place, gently bumping into each other.  Through a chain reaction, all students begin moving.

**4.** Tell students they are now liquid.  As a liquid, students should stay close together.

**5.** Add more heat; the liquid turns into gas.  In its gaseous state, water molecules move freely.  Students step away from each other and roam randomly around the room.  Music may enhance the flow of "molecules" around the room.

**6.** Explain that eventually heat energy will be lost.  The loss of heat energy is represented by the flashlight with the blue filter.  (Heat travels from the molecule to the colder object.)

**7.** Shine the blue flashlight on a group of students.  Droplets of water form around the room as molecules lose energy and move together.  After all the students are liquid, continue to shine the blue light (representing a continued loss of energy) on students until they become ice.

**Wrap Up**

Have students write in their own words or draw a picture or diagram to represent how water behaves in each state and what happens during the transition from one state to another.  Provide students with a scenario, such as a glass of ice set on a sunny porch, and have them describe in molecular terms what is happening to the ice.  Have students keep their descriptions of molecules in motion in a handy place to be used as reference when learning other water concepts.

**Rubric                               4                                     3                                  2                           1**

**Analyzing** Effectively identify and simulate    Able to simulate the         Unable to identify   Poor

the pattern of molecules in all      movement of molecules     or simulate            unders-

states of water                                                                                              tanding

**Interpreting** Demonstrate and compare          Good understanding of      Lacks clear           No unders-

effectively the movement of         molecule movements        understanding        tanding

water molecules

**Presenting** Knowledge of molecules'             Lack of details in              Major writing         Unclear

                           movement represented in            scripted representations    and drawing

                           a creative scripted way,                                                     errors

                           (writing/drawing)